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AGGLOMERATED QUICKLIME OR DOLOMITIC QUICKLIME COMPOSITIONS FOR ELECTRIC ARC FURNACE STEELMAKING

FIELD OF THE INVENTION

The present invention relates to agglomerates of quicklime or dolomitic quicklime which have physical and chemical characteristics superior to other lime compositions. The quicklime or dolomitic quicklime agglomerates are especially useful as a slag forming material for use in injection into electric arc furnace steelmaking processes.

BACKGROUND TECHNOLOGY

Advances in steelmaking have led to processes where lime is injected into an electric arc furnace for use as a slag forming material. Systems are proposed where lime has been injected into an electric arc furnace by means of a retractable door lance. Lime is, however, a readily friable material and lime sizing for such electric arc systems is inconsistent, with fine lime material carried over into the exhaust from the system, so as result in inefficient lime consumption and poor control of the slag chemistry in the electric arc furnace.

In side wall injection systems, lime sizing of 3mm to 13mm has

been used with oxygen blended into an air transport system for feeding the lime. It has been found that use of lime particles of less than about 3 mm can result in clogging of the injectors used to charge the lime to an electric arc furnace. High air transport rates are required to avoid this clogging problem. The problem of lime fines exhausted to an electric arc furnace system also exists. The irregular nature of the size of lime products and the friability of the lime aggravates this problem.

In an existing system for side wall injection of lime into an electric arc furnace, a water cooled side wall injector can be used, having a free bore of 2 to 3 inches in diameter with flow rates of about 550 to 880 pounds per minute (250 to 400 kg/min.) of lime. Limitations on lime sizing is still a factor because of the aforementioned problems of clogging and evacuation of fine lime material to an emission system of an electric arc furnace. Also, such inconsistency in sizing and physical characteristics of the lime still creates inconsistency in control of slag chemistry and process control in the electric arc furnace system.

SUMMARY OF THE INVENTION

Agglomerates of quicklime or dolomitic quicklime, which are especially useful as a slag forming material in an electric arc

furnace steelmaking process, contain quicklime or dolomitic quicklime formed into agglomerates with a non-aqueous binder, which agglomerates have a particle size in the range of about 1.0 to 20 mm. At least 90 percent of the agglomerates are of a particle size within about 60 percent, preferably within about 25 percent, plus or minus, of a predetermined particle size within the specified range.

DETAILED DESCRIPTION OF THE INVENTION

Agglomerates, especially useful as a slag forming material in an electric arc furnace steelmaking process, are formed from calcium components.

The calcium component that is used to produce the present agglomerates is quicklime (CaO) or dolomitic quicklime (CaO-MgO).

Formation of the agglomerates is by mixing quicklime or dolomitic quicklime, of a particle size less than 0.5 mm, with a non-aqueous binder and forming the material into granules, pebbles or pellets. Examples of the non-aqueous binder are waxes and starches. The non-aqueous binder is present in an amount of less than about 20 percent by weight of the agglomerates.

The size of the agglomerates is important and such agglomerates are of a particle size in a range of about 1.0 mm to

20 mm. In addition, it is important that the particle size of the agglomerates, in addition to being within a size range of about 1.0 mm to 20 mm, have a relatively consistent particle size. Thus, at least 90 percent, by weight, of the agglomerates should have a particle size within about 60 percent, preferably within about 25 percent, plus or minus, of a predetermined particle size within the range of 1.0 to 20 mm. Thus, if a particle size of 10 mm is a predetermined particle size of agglomerates, at least 90 percent of the agglomerates should fall within a range of 4.0 mm to 16.0 mm, preferably 7.5 to 12.5 mm, or if a predetermined particle size is chosen as 6.0 mm., at least 90 percent of the agglomerates should fall within a range of 2.4 mm to 9.6 mm, preferably 4.8 to 7.2 mm.

Agglomerates where prepared according to the present invention and compared with particles of high calcium lime (Hi-Cal: 98% CaO) having a particle size of 0.25 inch (6.35 mm.) or less. The agglomerates (product) were prepared using 20 percent by weight of wax (waste candle wax sold by Yankee Candle Co.). The particle size of the agglomerates was as follows:

Size (8" Tyler screens)

Screen openings

(mm)	% retained	% passing
9.51	0.000	100
8	0.000	100
6.35	1.840	98.2
5.66	3.650	94.51
4.76	13.690	80.82
3.36	35.090	45.73
2.38	32.440	13.29
1.41	8.090	5.2
1.19	0.250	4.95
0.1	4.95	
Total	100.000	

Thus, using 3.52 mm as a predetermined particle size, over 90 percent of the particles are within plus or minus 60 percent of that predetermined particle size, or in the range of 5.623 mm to 1.408 mm.

The strength of the agglomerates was tested and showed the following results:

STRENGTHS (+4 MESH PELLETS)

COMPRESSION[1] (LBS.) **18 Inch Drop on Flat Steel Surface**

Pellet	As Rec'd	Hot Melt pellets	Pellet	As Rec'd	Hot Melt Pellets
1	15	25+	10	20+	20+
2	25+	14	11	20+	20+
3	<10	25+	12	20+	20+
4	5-10	25+	13	20+	20+
5	5-10	25+	14	20+	20+
6	12	25+			
7	10	25+			
8	10	25+			
9	10	25+			

[1] Applied down pressure to pellet with a flat device on a weighing scale

Resistance to Abrasion and Impact

Product larger than 8-mesh was tumbled in the mill for 16 minutes. The degradation (minus 8 mesh) of the product was 4.8% and the Hi-Cal was 13.5%. A 9" rotating drum with opposing end plates (60 RPM for 16 min. = 1000) was used.

Temperature Sensitivity

The product was placed in a non-convection oven for 24 hrs. in a sealed plastic specimen cup. The appearance and strength of the product did not change. It did not agglomerate or feel soft to the touch at the higher temperatures. In a sealed container at 25°C, 66°C, 100°C. Separate sets were used in each test.

Shelf Life (Exposed to atmospheric air in a glass dish)

Even though the product had greater strengths and less abrasion than the Hi-Cal the shelf life appears to be about the same. The product was exposed to air for 7 days and after 3 days the outer layers of the product peeled like eggshells. The product had virtually no strength after 3 days.

PERCENT CARBON

	%Carbon	%Sulfur
Hi-Cal (0.25 inch or less)	0.0864	0.0344
	0.0844	0.0289
Product	12.0	0.0895
	12.0	0.0726
	13.1	0.0725
	13.7	0.0887

In an electric arc steelmaking process according to the present invention, agglomerates of quicklime or dolomitic quicklime, as above-described, are injected into the slag and/or metal in an electric arc furnace as a slag-forming material. The agglomerates are injected into the slag and/or metal through injectors using a flow of air, preferably enriched with oxygen. Preferably, water cooled fixed side wall injectors are used.

The agglomerates used in the present electric arc furnace steelmaking process are agglomerates of quicklime or dolomitic quicklime that contain a non-aqueous binder, the agglomerates, having a particle size in a range of about 1.0 mm to 20 mm with at least 90 percent of said agglomerates having a particle size within 60 percent, preferably within 25 percent, plus or minus, of a predetermined particle size within said range.

The use of the agglomerates above-described enables the feed thereof into an electric arc furnace, and preferably through a side wall injector into an electric arc steelmaking furnace process without the problem of clogging of an injector or substantial loss of fine material to an emissions system of the electric arc furnace. Such agglomerates also allow for improved fluidizing of the lime for transport through an injector into the slag or liquid metal in an electric arc furnace steelworking system.

A test was performed to determine the pneumatic transportation capability of the composition of the present invention. Agglomerates (product) were transported by dry air through a flexible hose of 36 mm. internal diameter and 20 meter (65.62 ft) length. The dry agglomerates did not present any problem and were conveyed very easily with a dispenser inner pressure of 1.5 Bar (21.76 pounds/in.^{2}) and a transport pressure of 1.2 to 1.5 Bar (17.40-21.76 pounds/in.^{2}). It is believed that such agglomerates could be easily conveyed for a linear distance of up to 80 meters (262.5 ft.), which would readily enable transport from a source to the injectors in a side wall of an electric arc furnace.